CROSS SECTIONAL AND LONGITUDINAL TRAJECTORY OF STUDENTS' PERFORMANCE IN MATHEMATICS IN SECONDARY SCHOOL CERTIFICATE EXAMINATION

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Abstract

The study examined the cross sectional and longitudinal trajectory of students' performance in Mathematics in the external examination. It also investigated the influence of students' grade variations (A1, B2-B3, C4-C6, D7, E8, F9) students' disciplines (Art, Science, Commercial) on students' performance in Mathematics over the longitudinal period of three sessions from 2014/2015, 2015/2016, 2016/2017 in external examinations. The study adopted an ex-post facto design of descriptive research. The sample used for this study was 2120 students. Multistage sampling procedure was employed, while, school A-F were cross sectionally and randomly selected across the three geopolitical zones in the state. The instrument used for the study was the secondary school Academic Performance Results Inventory in Mathematics (SSAPRIM). The findings shows that there exists no significant relationship in students' performance in Mathematics from 2014-2017 in all schools under consideration. There is also a significant difference in the students' performance in Mathematics and their grades. Based on the findings of this study, it was recommended among other things that Mathematics lesson should be improved upon so that the fluctuation of students' results in internal and external examination would become a thing of the past.

Keywords: *cross-section trajectory; longitudinal trajectory; students' performance; examination.*

Introduction

Mathematics has become a precursor to the much needed technological scientific development of nay nation in the world. Its understanding has become a subject of global discourse, which cannot be undermined in human's minds. Adeyemi (2007) gave reasons why most candidates find it difficult to pass their examinations, such reasons include having to repeat classes, lack of inadequate knowledge in their various subjects, inadequacy of professionally qualified teachers in schools and insufficient facilities. These reasons might perhaps have led to the unprecedented failure recorded in Mathematics over the years in West Examination Council School Certificate.

The dismal of West African Examination Council (WAEC) may be a result of the careless attitude of the government y its refusal to adequately fund the education sector. The dwindling budgetary allocation in the education sector has been detrimental to the development of education sector in the country. United Nations Educational, Scientific and Cultural Organization (UNESCO) recommended that 26 percent of any country's budget should be allocated on education sector, but instead poor allocation by the Nigerian government persist. Other countries that understand the importance of

education has taken proactive steps to adequately fund their education sector. Ghana for example allocates 29 percent to its budget on education sector, even more than the UNESCO'S recommendation. The same in South African with allocation of 35 percent to her education sector. If Nigeria fails to implement UNESCO's recommendation on education on education budgetary allocations, the future of Nigerian child is still in jeopardy.

Underperformance in Mathematics is particularly recognized as a major problem in schools in Nigeria (Oginni, 2016) as a result of misconception in the teaching of the subject. Some researchers (Alio & Ogbu, 2016) have suggested that students do not possess the skill that would enable them function effectively in the society. These include learners' ability, attitudes and perceptions, family and socio-economic background, parent and peer influencers, school related variables such as poor learning, environment, learning cultures and teachers curriculum, school and class size and effectiveness of school.

WAEC Chief Examiner's report (2018) revealed that 30.09% (94,607 candidates) obtained A1-C6 IN Mathematics, 109,069 candidates representing 34.72% also obtained D7-E8 while 99,275 (31.58%) obtained F9 in Mathematics. He attributed the failure to their avoidable engagement in social media at the detriment of their academics. However, it has been observed on yearly basis, particularly in some schools in the state, especially in 2014 and 2015, that the percentage of candidates that obtained credit in five subjects and above ,including English and Mathematics was 31.28 and 38.68 percent respectively (Thisday Newspaper, August. 16, 2016).

Gender differences in Mathematics achievement and ability has remained a source of concern (Asante, 2010). Gender differences in secondary Mathematics are a prominent issue that has been the focus of many studies, while reported differences in Mathematics between boys and girls as contentious. Some studies have shown girls outperforming girls (Stevens, Wang, Olivarez & Hamman, 2007), while others find boys performing better than girls. Contrary to these was the study of Oginni & Owolabi (2013) on gender that there was homogeneity in the performance of students in Mathematics in special students.

Science discipline at the ordinary level in secondary schools in Nigeria is among the high profile area where Mathematics is made compulsory, because of its application to other science subject like Physics and Chemistry cannot be underrated. English Language is popular among art students. Nevertheless both subjects are compulsory at that level. The poor performance of science, art and commercials students in Mathematics has raised a concern due to the fact that country aims at achieving high technological advancement bin the 21st century. The percentage of the students who scored grade A-C has been very low in science subjects compared to non-science subjects. The future of our society will be determined by the citizens whoare able to understand and help shape the complex influences of science, art and commercial subjects on our world (Ungar, 2010). There are marked differences in the students' outcomes in Mathematics. Some of the students have a feeling that Mathematics are tough for them, hence they shy away from class (Siwel & Kizito, 2012).

Schools with the basic infrastructure like textbooks, instructional materials, well-

equipped laboratory, standard building and necessary resources may perform much better than schools which do not have these resources in senior secondary certificate examination (Ambogo, 2010). Another factor that affects Mathematics students' performance in WASSCE is curriculum. The International Mathematics Study (Schmidt et al, 1996) sponsored by the International Association for Evaluation of Educational Achievement (IEA) considered the study of Mathematics at three levels ranging from art, commercial and science classes.

Some of the related factors that affect students' performance in school may be class size, unconducive environment, ineffective teaching methods, and unqualified teachers among others. Most of the secondary school students could have not register for Mathematics examination during West African Senior Secondary Certificate Examination (WASSCE) if the subject is optional. This action of high rate of absenteeism, students' poor attitude towards the subject could be as a result of perceiving the subject to be an imposition on them. Based on the unending importance of mathematics in nation building, it is therefore imperative to investigate the cross sectional and longitudinal trajectory of students' performance in secondary school certificate examination.

Methodology

The study adopted an ex-facto design of descriptive research. The sample used for this study was 2120 students. Multistage sampling procedure was employed. Stage one involved the selection the selection of two Local Government Areas from each local Senatorial District of the state. Stage two involved the selection of schools from each local government termed A, B, C, D, E and F school with the entire students' result in the six zones utilized. The instrument used for the study was Secondary School A academic Performance Inventory (SSPAI) which contains the grades obtained by students in WASSCE results in Mathematics, which varied from the candidates grades ranges from distinction, credit passes (A1, B2, B3, C4, C5 and C5) pass and fail (D7, E8 and F9), for the year 2014 to 2017 in Ekiti State. The sex and disciplines (Arts, Commercial and Science students) of students inclusive based on their subject offered during examination. The instrument has been standardized by WAEC. A research question was raised and three hypotheses were formulated. The data were analyzed by using descriptive such as graph and bar chart while inferential statistics was used to test the hypotheses such as correlation, Analysis of Variance (ANOVA) and Duncan Multiple range test.

Research Question

What are trends of students' performance in School A, B, C, D, E & F Mathematics from 2014 to 2017?

Research Hypotheses

1. There is no significant relationship in the students' performance in WASSCE Mathematics examination form 2014 to 2017 considering the different schools
2. There is no significant difference in the performance of students' that obtained credit and above (A1-C6) and Pass (D7-F9) in the May/June WASSCE in Mathematics form 2014-2017
3. There is no significant difference in the performance of students' in Mathematics in Art, Science and Commercial in 2014 to 2017.

Results

What are the trends of students' performance in Mathematics from 2014-2017?

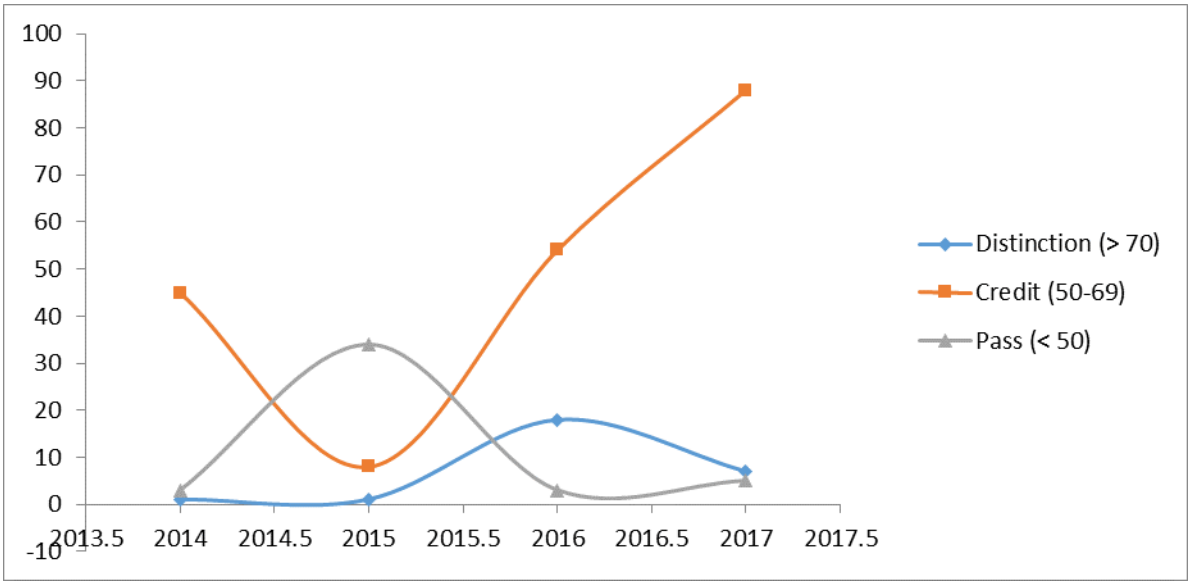
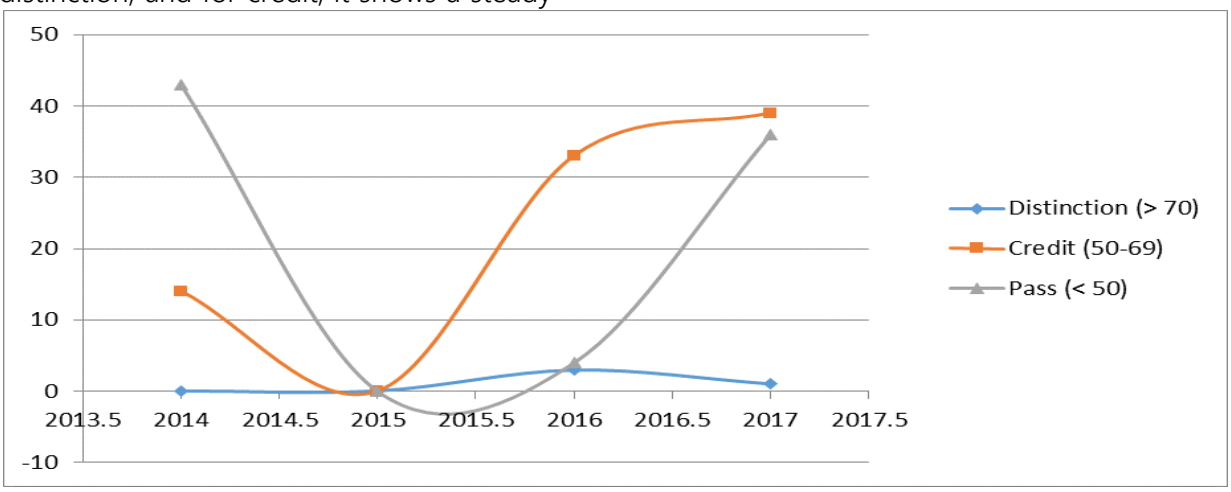


Fig. 1: *Graph of students' performance in Mathematics from 2014 to 2017 (School A)*

Fig. 1 shows a linear movement (though very low) in 2014 and 2015 and experience a steady increase in 2016 before it declines again in 2017 for the students with distinction, and for credit; it shows a steady rise in 2014, 2016 and 2017, but low in 2015. The pass level was very low in 2014, and later rose in the year 2015, and eventually dropped in 2016 and 2017 respectively.



Comparative analysis of WASSCE students' performance in Mathematics from 2014-2017 (School B).

Fig 2: *Graph of students' performance in Mathematics for 2014 – 2017 (School B)*

Fig. 2 shows that there was no distinction in the performance of the students in the year 2014, while it rose up slightly in 2016 it comes down again the year 2017. For credit, there was a steady downward trend from 14 in 2014, 2016 and 2017 but a sharp downward trend in 2015. It also shows no pass in 2014 but we see to 2016 it increase to 4 and ever rose far higher in 2017 to 37.

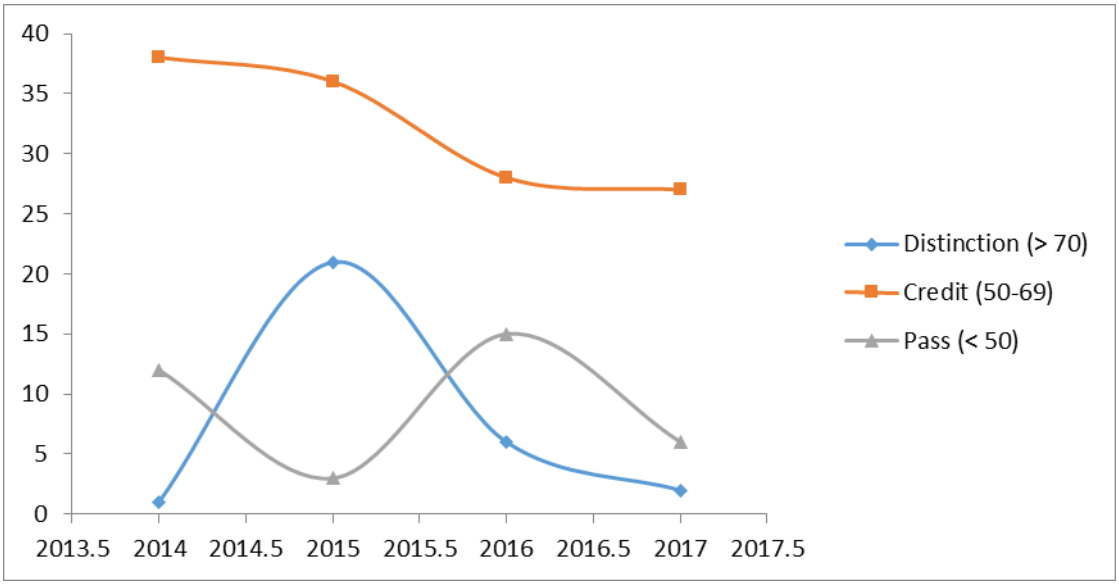
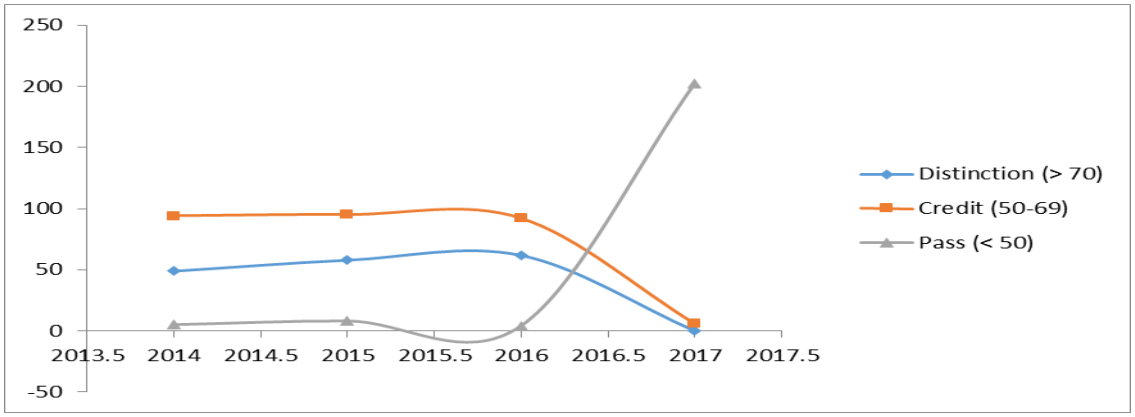


Fig 3: *Graph of student performance in Mathematics from 2014 to 2017 (School C)*

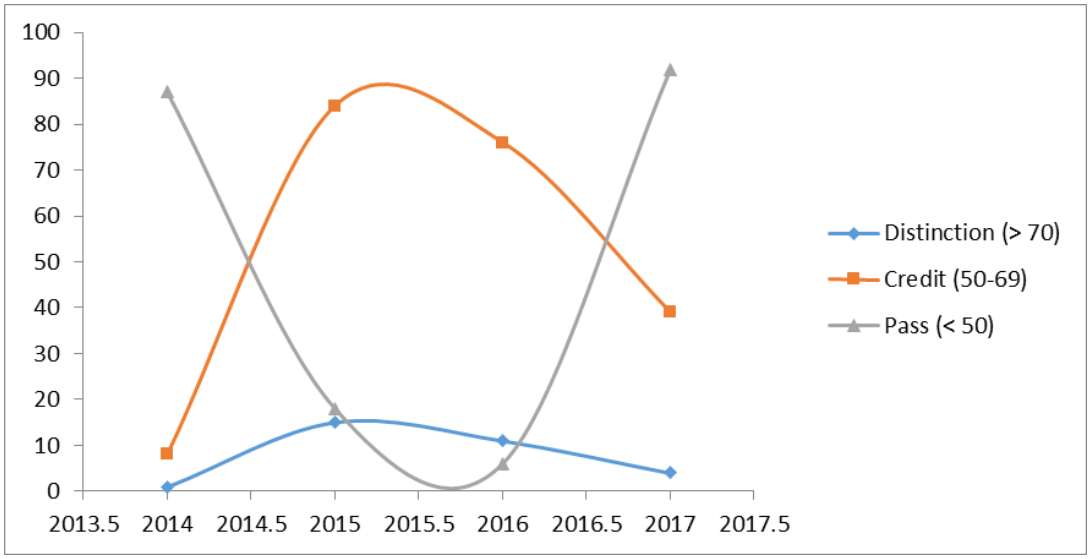
Fig 3 shows that from 2014 to 2015, there was a sharp increase in the distinction level but decrease in 2016 and further decline in 2017. Also in 2014 to 205 there was a steady linear and high relation in the level of increase in the students' performance with credit in Mathematics but reducing slightly for 2016 to 2017 in a linear trend although still high. However, there is sinusoidal movement in the pass level in 2014 to 2015 and from 2015 to 2016 and suffers a downward trend in 2017 which implies a fluctuation in pass level.



Comparative analysis of WASSCE students' performance in Mathematics from 2014-2017 (School D)

Fig. 4: *Graph of students' performance in Mathematics from 2014 to 2017 (School D)*

Fig 4 reveals that there was a low and linear relationship in distinction grade of students' performance in school D form 2014 to 2016 until the diminishing return set on the performance form 2014 to 2016. There was averagely credit linear relationship in students' performance from2014 to 206 until it reduces to nearly zero in 2017. However for pass grade level; there was nearly zero level performance in pass from the year 2014, 2015 and 2016 until it rose sharply and surprisingly to 200 above in 2017.



Comparative analysis of WASSCE students' performance in Mathematics from 2014-2017 (School E)

Fig. 5: *Graph showing students' performance in Mathematics from 2014 to 2017 (School E)*

Fig 5 shows that, in 2014, the distinction level was extremely low, the credit level was likewise very low while the pass level was very high, for 2015 the distinction level was very low while the credit level moved surprisingly form extremely low to a very high level while the pass was equally moderately. In 2016, the credit level reached its highest credit level and later dropped in 2016 and further reduction in 2017. The pass level of students was at the highest in 2014 and 2017 but it reduces in 2015 to its lowest in 2016.

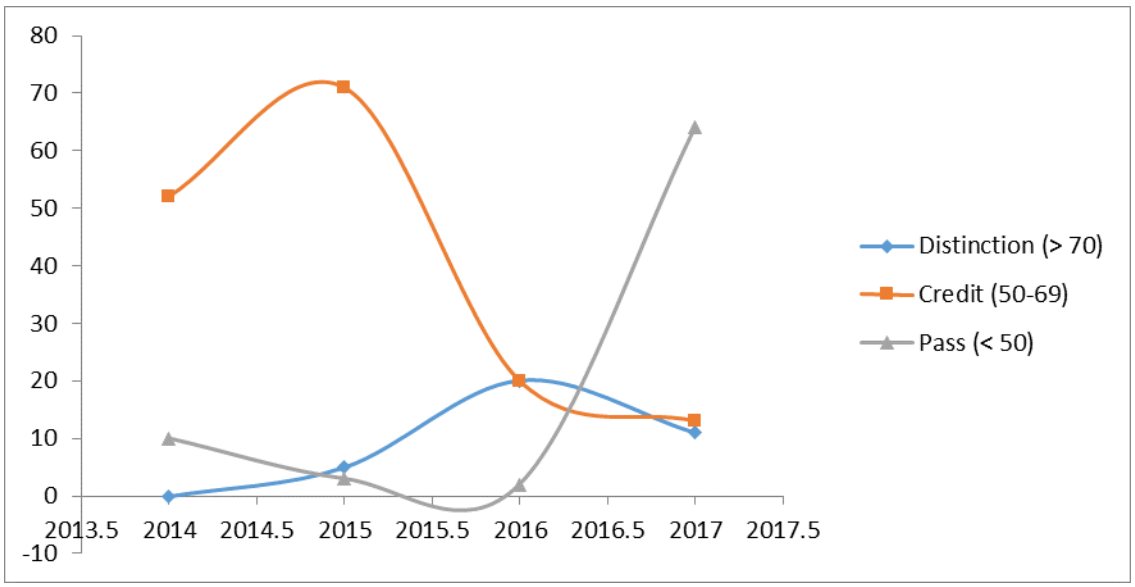


Fig. 6: *Graph of students' performance in Mathematics from 2014 to 2017 (School F)*

Fig 6 shows a non-stationary movement in the performance of students at distinction level it started from zero level in 2014 and increase steadily up to year 2016 until it

decline slightly in 2017 for credit level it move from lower in 2014 with slight increase in 2015 and decline sharply up until 2017. Considering pass level, it experienced a downward trend to 2016 until it rose sharply in 2017.

Hypotheses Testing

The null hypotheses postulated were tested at 0.05 level of significance in this study

1. There is no significant relationship in the students' performance in WASSCE Mathematics examination from 2014 to 2017 considering different schools as shown in Table 1

Table 1: Duncan Multiple Range Test for students' performance in WASSCE Mathematics from 2014 to 2017 in School A.

Alpha	0.05	No of mean	2	3	4	Means with the same letter are not significantly different			
Error DF	8	Critical value	58.41	60.86	62.24	Duncan grouping	mean	N	Years
Error Mean Square	962.25					A	33.33	3	2017
						A	25.00	3	2016
						A	16.33	3	2014
						A	14.33	3	2015

Table 1 shows the variations in mean to be 33.33,25.00,16.33 and 14.33. This implies that there exists no significant relationship in students' performance in Mathematics from 2014-2017 in School A. Hence, the null hypothesis (for school A) is not rejected.

Table 2: Duncan Multiple Range Test for students' performance in Mathematics from 2014 to 2017 in School B.

Alpha	0.05	No of mean	2	3	4	Means with the same letter are not significantly different			
Error DF	8	Critical value	28.81	30.03	30.70	Duncan grouping	mean	N	Years
Error Mean Square	234.1667					A	20.00	3	2015
						A	17.00	3	2014

Table 2 shows the mean variation of 20.00, 17.00,16.33 and 11.67respectively.Which implies that there exists no significant relationship in the mean differences of students' performance in Mathematics from 2014-2017 in School B. Hence, the null hypothesis (for School B) is not rejected

Table 3: Duncan Multiple Range Test for students' performance in Mathematics from 2014 to 2017 in School C.

Alpha	0.05	No of mean	2	3	4	Means with the same letter are not significantly different

Error DF	8	Critical value	28.81	30.03	30.70	Duncan grouping	mean	N	Years
Error Mean Square	234.667					A	20.00	3	2015
						A	17.00	3	2014

Table 3 shows the variations in mean 20.00, 17.00 16.33 and 11.67. This implies that there exists no significant relationship in students' performance in Mathematics from 2014-2017 in School C. Therefore, the null hypothesis (for School C) is not rejected.

Table 4: Duncan Multiple Range Test for students' performance in Mathematics from 2014 to 2017 in School D.

Alpha	0.05	No of mean	2	3	4	Means with the same letter are not significantly different			
Error DF	8	Critical value	130.1	135.6	138.6	Duncan grouping	mean	N	Years
Error Mean Square	4774.333					A	69.33	3	2017
						A	53.67	3	2015

Table 4 shows mean variations of 69.33,53.67, 52.67 and49.33 respectively. Which implies that there exists no significant relationship in students' performance in Mathematics from 2014-2017 in School D. Hence, the null hypothesis (for School D) is not rejected.

Table 5: Duncan Multiple Range Test for students' performance in Mathematics from 2014 to 2017 in School E.

Alpha	0.05	No of mean	2	3	4	Means with the same letter are not significantly different			
Error DF	8	Critical value	80.36	83.76	85.65	Duncan grouping	mean	N	Years
Error Mean Square	1822.5					A	45.00	3	2017
						A	39.00	3	2015

Table 5 shows mean variations of 45.00, 39.00, 32.00 and 31.00. This implies that there exists no significant relationship in students' performance in Mathematics from 2014-2017 in School E. Hence, the null hypothesis (for School E) is not rejected.

Table 6: Duncan Multiple Range Test for students' performance in Mathematics from 2014 to 2017 in School F.

Alpha	0.05	No of mean	2	3	4	Means with the same letter are not significantly different

Error DF	8	Critical value	53.83	56.09	57.36	Duncan grouping	mean	N	Years
Error Mean Square	817.25					A	29.33	3	2017
						A	26.33	3	2015

Table 5 shows variations in the means of 29.33, 26.33, 20.67 and 14.00 respectively. Which implies that there exists no significant relationship in students' performance in Mathematics from 2014-2017 in School F. Hence, the null hypothesis (for School F) is not rejected.

Hypothesis 1: There is no significant difference in the performance of students that obtained credit and above (A1 – C6) and Pass (D2 – F9) in the May/June WASSCE in Mathematics from 2014 to 2017.

Table 7: ANOVA Summary of Students' Performance in Terms of Grading

Source	Df	Sum of Squares	Mean Square	F value	Pr > F
Model	2	10491.26316	5245.63158		
Error	54	72369.57895	1340.17739	3.91	0.0259
Corrected Total	56	82860.84211			

Table 7 shows that $F_{(2, 54)} = 3.91$, $P < 0.05$ at 0.05 level of significance. Hence, the null hypothesis is rejected. This implies that there is a significant difference in the students' performance in Mathematics in terms of their grades.

Hypothesis 2: There is no significant difference in the performance of students in Mathematics in Art, Science and Commercial in 2014 to 2017.

Table 8: ANOVA Summary of students' performance in Mathematics in terms of Discipline

Source	Df	Sum of Squares	Mean Square	F value	Pr > F
Model	2	1795.142857	897.571429		
Error	18	1618.857153	89.936508	9.98	0.0012
Corrected Total	20	3414.00000			

Table 8 shows that $F_{(2, 18)} = 9.98 < 0.05$ at 0.05 level of significance. Hence, the null hypothesis is rejected. This implies that there is no significant difference in the students' difference in the students' performance in Mathematics in the area of Art, Commercial and Science.

Hypothesis 4: There is no significant difference in the performance of students' in Mathematics from 2014-2017.

Table 9: ANOVA Summary of Students' Performance in Mathematics form 2014 – 2017 (School A)

Source	Df	Sum of Squares	Mean Square	F value	Pr > F
Model	3	684.250000	228.083333		

Error	8	7698.00000	962.250000	0.24	0.8681
Corrected Total	11	8382.250000			

Table 9 shows that $F_{(3, 8)} = 0.24$, $P > 0.05$ at 0.05 level of significance. Hence the null hypothesis is not rejected thus implies that there is no significant difference in the comparative analysis performance of students' in Mathematics from 2014 to 2017 WASSCE.

Table 10: ANOVA Summary of Performance of Students in Mathematics from 2014-2017 in WASSCE. School B

Source	df	Sum of Squares	Mean Square	F value	Pr > F
Model	3	684.250000	228.083333		
Error	8	7698.00000	962.250000	0.24	0.8681
Corrected Total	11	8382.250000			

Table 10 shows that $F_{(3, 8)} = 0.24$, $P > 0.05$ at 0.05 level of significance. Hence the null hypothesis is not rejected thus implies that there is no significant difference in the comparative analysis performance of students' in Mathematics from 2014 to 2017 WASSCE.

Table 11: ANOVA Summary of Students' Performance in Mathematics form 2014 – 2017 in WASSCE Mathematics in School C

Source	df	Sum of Squares	Mean Square	F value	Pr > F
Model	3	106.916667	228.083333		
Error	8	1873.33333	962.250000	0.15	0.9254
Corrected Total	11	1980.250000			

Table 11 shows that $F_{(3, 8)} = 0.15$, $P > 0.05$ at 0.05 level of significance. Hence the null hypothesis is not rejected thus implies that there is no significant difference in the comparative analysis performance of students' in Mathematics from 2014 to 2017.

Table 12: ANOVA Summary of Students' Performance in Mathematics form 2014 – 2017 in WASSCE Mathematics in School D

Source	df	Sum of Squares	Mean Square	F value	Pr > F
Model	3	715.58333	238.52778		
Error	8	38194.66667	4774.333333	0.05	0.9842
Corrected Total	11	38910.25000			

Table 12 shows that $F_{(3, 8)} = 0.05$, $P > 0.05$ at 0.05 level of significance. Hence the null hypothesis is not rejected. Thus, there is no significant difference in the comparative analysis performance of students' in Mathematics from 2014 to 2017.

Table 13: ANOVA Summary of Students' Performance in Mathematics form 2014 – 2017 in WASSCE Mathematics in School E

Source	df	Sum of Squares	Mean Square	F value	Pr > F
Model	3	386.25000	128.75000		
Error	8	14580.00000	1822.50000	0.07	0.9740
Corrected Total	11	14966.25000			

Table 13 shows that $F_{(3, 8)} = 0.07$, $P > 0.05$ at 0.05 level of significance. Thus, the hypothesis is not rejected. This implies that there is no significant difference in the comparative analysis of the performance of students' in Mathematics from 2014 to 2017 in School E.

Table 14: ANOVA Summary of Students' Performance in Mathematics form 2014 – 2017 in WASSCE Mathematics in School F

Source	df	Sum of Squares	Mean Square	F value	Pr > F
Model	3	410.916667	136.972222		
Error	8	6538.00000	817.250000	0.17	0.9153
Corrected Total	11	6948.916667			

Table 14 shows that $F_{(3, 8)} = 0.17$, $P > 0.05$ at 0.05 level of significance. Thus, the hypothesis is not rejected. This implies that there is no significant difference in the performance of students in Mathematics from 2014 to 2017 in School F..

Table 15: Correlation Summary Students' Performance in Mathematics from 2014 – 2017

		Year 2014	Year 2015	Year 2016	Year 2017
Year 2014	Pearson Correlation	1	0.444	0.434	0.067
	Sig. (2 tailed)		0.098	0.106	0.814
Year 2015	Pearson Correlation	0.444	1	0.446	0.273
	Sig. (2 tailed)	0.098		0.096	0.324
Year 2016	Pearson Correlation	0.434	0.446	1	0.369
	Sig. (2 tailed)	0.106	0.096		0.176
Year 2017	Pearson Correlation	0.067	0.273	0.369	1
	Sig. (2 tailed)	0.814	0.324	0.176	

Table 15 shows that there is a weak relationship in students' performance in Mathematics between 2014 and 2015, 2014 and 2016, 2014 and 2017 with r = 0.444, r= 0.067 respectively. It was also discovered that year 2015 students' performance has a very weak relationship with 2016 and 2017 students' performance with r = 0.446 and r = 0.0273. Lastly, students' performance in year 2016 has a very weak relationship with students' performance in year 2017 with r = 0.369.

Discussion

The findings of this study revealed that the cross-sectional and longitudinal trends in students' performance in Mathematics for

distinction was generally low, followed by credits and higher number of students with pass in 2014 and 2017. This supported the Sun News report that 1.6 million of students that took 2014 May/June WASSCE, only a little more than half a million (31.28%) passed with the minimum requirement for admission into the tertiary institution (The Sun News, Outrage trails of students' poor performance 2014).

The study shows that there is no significant relationship in the students' performance in Mathematics from 2014 to 2017 in all the schools under consideration. This is in line with the work of Asante (2010) that students' performance in Mathematics has not improved despite its importance even with the introduction and use of technology.

The findings of the study also revealed that there is significant difference in the students' performance in Mathematics and their grades which implies that although there was no significant relationship in the students' performance, their grades differs significantly and this may be due to different factors such as attitudes, beliefs, learner's abilities, perceptions, family and socio-economic status, parent and peer influences, class size, which is synonymous to the earlier study of Alio & Ogbu (2016) that students do not possess the skill that would enable them to function effectively.

The finding revealed further that there is significant difference in the performance of Mathematics between Commercial and Art students and also between Science and Art students as well as Commercial and Science students. This is supported by Agha (1998) that students who read Sciences (Physics, Mathematics and Chemistry) the way they read ordinary literature (story book), may not perform well in Mathematics. Also, it may be due to the fact that the same approach and method that some teachers use to teach Science and Commercial studies are used on Art students without considering their educational differences.

Also, the finding indicates a weal relationship in students' performance in Mathematics from the studied year. This was in agreement with the submission of Chief Examiner's report (2018) that the performance of students is poor on yearly basis. This may not be unconnected with the overreliance and overconcentration of students on whatsapp, facebook, twitter, instagramand other social media at the detriment of their studies.

Based on the findings of this study, the following recommendations were made:

1. That the government should reform and re-organize Mathematics curriculum in order to bring a positive effect on students' performance
2. Examination bodies (WASSCE, NECO etc.) should spread the Mathematics items evenly to cover the cognitive domain.
3. Students should not over rely on what the teacher teach but they must endeavor to look through the subject curriculum and syllabus and develop independent reading in order to cover the syllabus required by the examination bodies.
4. That effective teaching and learning of Mathematics at all levels of schooling should be ensured by all concerned stakeholders in order to reverse the trends of abysmal performance in Mathematics

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EFFECTIVENESS OF COMPUTER UTILIZATION IN THE TEACHING AND LEARNING OF SCIENCE AMONG SECONDARY SCHOOL TEACHERS IN EKITI STATE

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Abstract

This paper is a study on the effectiveness of the use of computer in the process of teaching and learning science in the secondary schools in Ekiti state, Nigeria. The study was a descriptive research of a survey type. Four research questions were raised and three hypotheses formulated. The sample for the study comprised 400 science teachers purposively selected from 50 secondary schools across the state. The research instrument was a questionnaire designed by the researchers titled 'Effectiveness of Computer Use in Teaching and Learning of Science' and was administered personally by the researcher. The data obtained were subjected to descriptive analysis of mean and percentages and inferential statistics of X^2 and F-ratio tested at 0.05 level of significance. The results of finding revealed that most of the science teachers have Computer but do not make use of it in their teachings, even though they have the believe that the use of Computer could enhance teaching and learning of science. Based on these outcomes, it was